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GEOGRAPHICAL NOTES IN ALASKA.

BY

WM. H. DALL, *U. S. Geol. Survey.\**

At the last session of Congress the U. S. Geological Survey was required to report upon the resources in gold and coal of the Territory of Alaska, and a sum of five thousand dollars was appropriated for the necessary fieldwork. Dr. Geo. F. Becker was appointed to take charge of the party and report upon the subject of gold-mining, and the writer to investigate the deposits of coal and lignite. As the means provided and the time available were both so restricted as to render a visit to the Yukon placer mines impracticable, our investigations were necessarily confined to the coast, where nearly all the deposits of gold or coal, other than placers, are accessible by ordinary steamers or vessels specially chartered.

Our party, completed by the addition of Mr. C. W. Purington of the Survey, left Tacoma, Wash., by the semi-monthly steamer on the 23d of May, reaching Sitka about a week later. Here by the courtesy of the Navy Department, the U. S. S. *Pinta* was placed at our service for work in the Alexander Archipelago. A month was spent here, and then the party sailed on the steamer *Dora*, which carries the mail westward to Unalashka once a month during the summer. Leaving the *Dora* at St. Paul, Kadiak Island, a small steam-tug of about 11 tons net burden was chartered for work among the Kadiak Islands, in Cook's Inlet, on the south shore of Aliaska peninsula, and westward to Sand Point, in the Shumagin

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\* Published by permission of the Director of the Survey.

group; where we met the *Dora* on her August trip and were carried by her to Unalashka. Here a short trip was made to the Gre-wingk and Bogosloff volcano islands and return, and leaving Unalashka by the steamer *Bertha* we returned direct to San Francisco.

The geological and economic data obtained will appear in the publications of the Survey, but many years' work on a reconnaissance of this coast under the auspices of the Coast Survey has led me to the habit of noting such geographical data as seem new or interesting. Such notes made on the voyage form the basis of the present paper.

The Coast Survey, in connection with the demands of the boundary commission, has been engaged for some years in a reconnaissance of the coast and islands of southeastern Alaska, to the great amelioration of the charts of that region. During the summer tourist steamers visit the principal points of interest, and consequently the scenery and even the geography of the wonderful fiords, glaciers and mountains of the Alexander Archipelago have become pretty well known, and are described in numerous books of travel. For the explorer in search of new material, other than minor detail, opportunity begins with the voyage to the westward. The *Dora* is a sufficiently comfortable little boat and puts into a multitude of rarely-visited harbors, trading posts and passages, offering to the tourist who is not a victim of sea-sickness exceptional advantages. Yet I believe, so far, she has never had a passenger except those whose impelling motive was commercial or government business.

On leaving Sitka the mail-boat proceeds to the northwest through the narrow Olga Strait and Neva Passage, bordered by picturesque green islands densely wooded with spruce, the forest broken here and there by brooks and water-falls. The Pacific is reached through Salisbury Sound, whose shores, especially to the north, are remarkably high and precipitous. Here navigators must be on their guard against the so-called "woollies," sudden gusts diverted by the cliffs from the upper currents of air, and which descend with great force for a few moments, tearing up the surface of the sea until it is white as wool, whence the name, and are liable to capsize even good-sized vessels if not securely ballasted. These gusts often come down without warning, in fair weather, when it may even be calm at the sea-level, and are justly dreaded by seamen.

The seaward shores of the archipelago, north of Salisbury Sound, are little known. They are guarded by a multitude of

wooded islands which protect numerous inlets and unsurveyed passages. The land is of moderate height and free from snow in summer. The water is deep, with rocky patches which afford excellent fishing. Becalmed off some of these islets in 1880 we caught the large red rock cod (*Sebastes*), a fish resembling the red snapper in general appearance, as fast as we could pull them in. Halibut also abounds in suitable places along this coast.

The proximity of Cross Sound is indicated by the appearance of tiny bergs borne by the ebbing tide from Taylor and Glacier Bays. They are fascinating objects in the sunshine, from the opaline tints of the ice, verging, in heavy masses, to the most beautiful robin's-egg blue.

North and west from Cross Sound, in clear weather, such as we were favored with, a panorama which I believe to be unique extends for two hundred and fifty miles. It is difficult to describe the Fairweather and St. Elias Alps in language which will not seem overdrawn. No language can express the sensations which the view affords to a lover of mountains. As mountains only the Himalaya can be compared with them for sublimity and beauty, and here we have not only mountains, but the sea. The principal peaks, like Fairweather, have a prismatic form, generally a sharp angular summit, with a lower buttress or shoulder on either side. The upper two-thirds are wrapped in eternal snow, the lower portions are wooded except where the numerous glaciers wind slowly to the shore. The foreland is narrow and usually rolling, sometimes a nearly level plain of glacial débris. Few of the glaciers actually reach the water, most of them stop short behind the beach. The sea hereabouts, for several miles from the shore, is generally covered with a thin milky layer of glacial water, the oceanic blue surging up only in the vessel's wake. In the Fairweather group there are numerous glaciers which in their upper slopes often take the form of ice cascades, the blue of the broken surfaces of ice conspicuous below the immaculate névé snow. This group is separated from the eastern extension of the St. Elias Alps by the wide ice-field called by La Perouse the Grand Plateau. Coasting within a few miles of the shore, as we did in 1874 and 1880, this seems an illimitable plain of ice; and was so described by me in the Coast Pilot of 1883. At a distance of ten or fifteen miles off shore, however, a relatively low mountain range is seen behind it, which I saw for the first time in 1895. Separated from the front of the Grand Plateau by a projecting spur, lies Dry Bay, a series of shallow glacial lagoons, in the midst of which rises a small, high, black

rocky island with bluff sides and wooded top. Concealed by overlapping spurs of the range and sometimes blockaded by a temporary advance of the ice is the cañon of the Altsek River, a stream which rises to the south and east near the head of Lynn Canal and which has, on rare occasions, been descended to its mouth. It is absolutely concealed by the topography, viewed from the sea, and the sketch given in Tebienkoff's Russian Atlas must have been made from a verbal description, for it bears no resemblance to the reality.

Thence to Yakutat Bay, a glacial plain, intersected by lagoons and streams abounding in salmon, extends between the mountains and the sea, with a width of some ten or twelve miles.

At Yakutat, the old native settlement on the Port Mulgrave spit is now abandoned for another site on the mainland opposite. Here are several trading establishments, and a Swedish mission.

The new native houses are imposing from a little distance, being high frame structures with rows of false windows externally. Inside there is but a single story open to the ridge pole. The great increase in the value of sea-otter fur has supplied the means for these pretentious but shabby houses, which have neither the stability nor the dignity of the aboriginal log-houses. One native at the time of our visit had three sea-otter skins for which he had refused a cash offer of \$900. He expected to get \$400 apiece. One of these hunters was about to give a feast and had imported on the *Dora* boxes of Oregon apples and other fruit for the occasion.

In 1874 I gave one of these people an orange, the first specimen of a cultivated fruit ever seen in this part of the world, and which was taken away, with a sort of reverential awe, wrapped in a clean cloth to be exhibited as an extraordinary curiosity to his less fortunate neighbors.

The St. Elias Alps, westward from Yakutat to Icy Bay, have been well described by Russell in several interesting papers, and I have recently \* given some account of the topographic and scenic features of the coast from St. Elias westward to Kaye Island. Before noting the new geographic features observed still further west, a few words on the cartography of the Gulf of Alaska and the Aleutian region are in order.

The earliest surveys which followed the rude sketches of the first Russian explorers; are due to naval officers in the service of Russia.

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\* Alaska Revisited, iv, The Nation, Vol. 61, No. 1573, pp. 131-2, 1895.

Krenitzin and Levasheff and later Sarycheff did useful work, and the latter prepared a series of charts which were engraved on copper and issued early in the century both as single sheets and collected in an atlas. Subsequently work of a more modern type and excellent quality was carried on and issued in a series of several sheets by the Russian Admiralty, 1847-8. While wanting in details of inlets and the shore-line of many of the off-shore islands, these charts\* represent an excellent reconnaissance and are in some respects still more reliable than any of those which have succeeded them. The United States exploring expedition under Ringgold and Rodgers in 1855 prepared an excellent chart of the Aleutians, which, however, was not issued by the U. S. Hydrographic Office until 1868. The navigators of the Russian-American Company brought in numerous local corrections to the central administration at Sitka, and these data accumulated until Capt. M. D. Tebienkoff, of the Russian Navy, who was acting as governor of the Colonies, conceived the idea of combining them in a new series of charts. Most of the contributors were German and Finnish seamen who had risen to the command of the company's trading vessels, but rarely were qualified for astronomical work. Their charts, therefore, while most useful for the navigator in these foggy regions, where seamen have to feel their way about by dead reckoning, were deficient in the precision of their astronomic data and rude in the execution of details. A rather remarkable circumstance was taken advantage of to fill out gaps in unsurveyed localities. The Aleuts, like the other Inuit people, have a remarkable capacity for drawing, especially maps of the region with which their hunting expeditions make them familiar. These maps lay down with the greatest detail every bend of the shore-line and every rock or reef where sea otters resort or a kayak might suffer injury. One may be certain that every item so placed upon the map has an actual existence, though its relative position may be distorted. By a very natural sequence, we find that the parts of the map adjacent to a village or camp are unconsciously drawn by the native artist on a larger scale than those portions of the same island which are less familiar and more distant. Topography is not attempted or is but rudely indicated, but everything which bears on the canoe life of these amphibious people is carefully set down.

I have several of these unpublished sketches, one of which is reproduced to illustrate their character. This particular sketch

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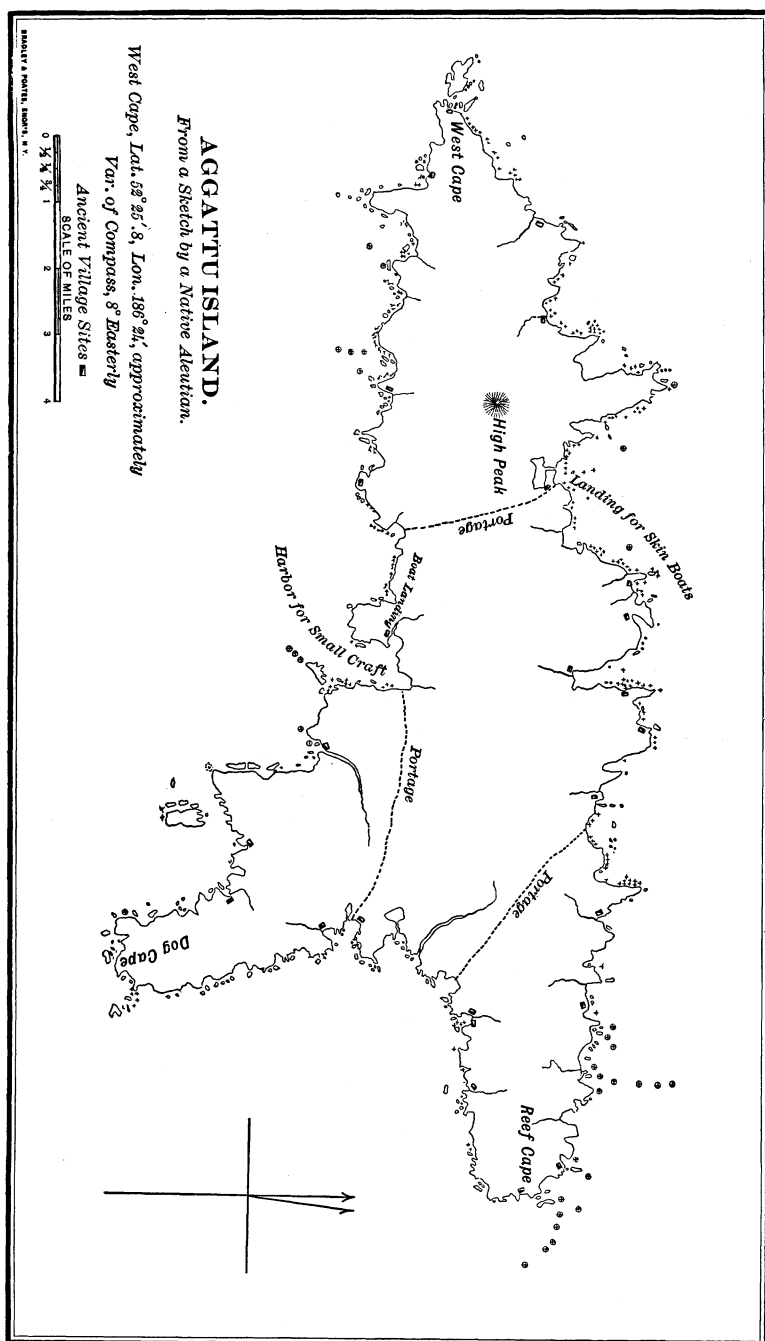
\* Pacific Ocean Series, Nos. 7, 8 and 9.

represents the island of Aggattu, uninhabited, except by temporary hunting parties, for more than half a century, and still unsurveyed. When discovered by the Russians it was densely populated, and on the sketch a little rectangle takes the place of the cross by which the native draughtsmen marked the site of each ancient village. The original sketch was in pencil on a large sheet of brown manila paper. From this a tracing was taken on linen and this reduced by photography. On the linen were added (by me) the compass, approximate scale of miles, and lettering needed for explanation. Though the island has never been surveyed, its limits and the position of its west cape were fixed by the U. S. North Pacific Exploring Expedition under Rodgers. The scale is derived from a subdivision of the length given by Rodgers' chart, that being taken to be the same on both charts. The orientation is obtained in an analogous manner, and the astronomical position given is taken from Rodgers.

If the latter's chart is correct, the island is really more triangular and consequently of greater area. The natives practically confine their residence to the coast where they watch for sea otter. Consequently the relatively unfamiliar interior is dwarfed on their map. The coast with all its rocks, either awash or above water, kelp patches and islets, is represented in the most minute detail. As there is no permanent settlement and the natives hunt all round the island, the relative size of the different ends is probably less discrepant than usual on such maps. The original drawing by a native Aleut, who cannot read or write or speak English, was kindly lent me some years ago by Mr. Lucien Turner, who obtained it directly from the maker. I have similar sketches of the Semitchee and Attu Islands. Tebienkoff utilized quite a number of these Aleut sketches in his Atlas, adjusting them as far as possible by compass bearings and crude astronomical observations made by his navigators. His charts were engraved on copper at Sitka by a native Aleut, and the Atlas with a series of notes in the Russian language was issued at Sitka and St. Petersburg in 1852.

From 1868 to 1880 the U. S. Coast Survey were engaged in reconnaissance work in this region, with some sixty local charts of harbors and passages as a result. The general charts were compilations from previous surveys with local corrections.

The Tebienkoff charts were printed on very poor paper and rapidly wore out. After the American purchase of Alaska the navigators of the trading companies soon began to need charts, and a surveyor named Applegate prepared a number of manuscript



charts for this purpose. The Applegate charts were based on those of Tebienkoff, and were put together with mediocre ability, but contained additional data furnished by the company's masters from time to time; usually dependent on a few compass bearings and rough observations for position. They really formed a patchwork upon patchwork, and ignored the Coast Survey work almost entirely. In many cases sketches which had been adjusted in the Coast Survey work by triangulation, were adopted by Applegate in all their original crudity; and no reliance whatever could be put on the astronomical positions employed.

When the U. S. Str. *Albatross* began her fishery explorations on the Alaskan coast and in Bering Sea, in 1888, the officers on board under Capt. Tanner's direction made various reconnaissance surveys intended to improve the charts. Most unfortunately, in bringing the new work together, under the mistaken impression that the Applegate charts were an advance on those which had preceded them in point of accuracy, the *Albatross* work was combined with the Applegate maps as a basis and published in the Report of the U. S. Fish Commission without any such detailed explanation as would have shown what part was due to Applegate and what to the *Albatross* officers. Very naturally the U. S. Coast Survey hydrographers, taking the whole as vouched for by naval officers, incorporated the discrepancies of this compilation into their general series of charts for this part of Alaska, and have been followed to some extent by other cartographers. The result is a distinct deterioration in accuracy and a confusion which it is probable will not be corrected until an entirely new series of surveys has been carried out over the region in question. The corrections, which in the course of this paper I may be obliged to make, will be understood better by the light of the preceding bit of cartographic history.

After leaving Kadiak on a little tug of about 11 tons net burden, the first point of interest at which we touched was the uncharted harbor on the north side of Cape Douglas, the southwest point of entrance to Cook's Inlet.

This anchorage is included between the rounded, rather low peninsula of Cape Douglas, composed of mostly horizontal andesitic lava beds more or less interstratified with ashes containing plant remains,—on the east, and a narrower cape on the west and north, which is composed of a very level layer of subcolumnar andesite rising about forty feet from the top of the steep beach. On the upper surface are scattered occasional erratics. To the south three glaciers are visible, two coming down south of Cape Douglas and one ending in

a stream which discharges into the southern part of the bight. The southernmost glacier is the largest. The shore about Cape Douglas is defended by numerous rocks and should not be approached too closely. Within the bay anchorage may be had in two to five fathoms under the west cape, where the bottom appears to be clear. The south and east parts of the bay are more or less shoal and rocky, and should be avoided. In entering, the navigator should keep the western shore aboard. Shelter may be had here in any wind except heavy northerly and northeasterly gales.

Leaving the cape, the northern slope of the mass of mountains behind it is seen to be snow-covered and with three very large snowy glaciers descending to the vicinity of the sea. The easternmost appears to be the largest, and showed an even snowy surface without lateral moraines. Northwest of the group of mountains is a space of comparatively low land crossing the peninsula behind the shoal and dangerous Kamishak Bay. Over these plains many caribou are said to range in summer.

Between Cape Douglas and Augustin Island, and about six or eight miles from the latter, are the Sea Otter Rocks, a low group not definitely placed on the charts. We steamed a straight course of NW.  $\frac{1}{2}$  W.\* from the Cape in calm, clear weather, which, according to the latest charts, would have carried us directly over the rocks, but in fact carried us about two miles west from them. At low water there were two low, flat table rocks, with a smaller pointed one between them, visible at a distance of two miles, the eye being ten feet above the water. At high water they are said to be awash. We brought them in one with a high bluff, which we supposed to be Pt. Bede, on the east shore of the inlet, bearing NE. by E. These rocks constitute a serious danger to navigation.

Augustin Island (otherwise Black Fox or Chernobura) is a typical volcanic peak, with low borders of talus. At present anchorage may be had in three and a half fathoms, sand, about a mile off shore, with the south point bearing SE. by S., the western point NW., and the peak NE. by E.  $\frac{1}{2}$  E. The south point is low and sandy, but the boat landing is best here, the beach running off very shoal north of it. The west point is composed of ashes and volcanic stones, forming low bluff banks and running off in flats upon which the boulders of volcanic rock, sometimes very large, are irregularly distributed. No chart of the island exists. There was formerly an excellent harbor for small craft on the west side,

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\* By compass.

and the inner harbor still exists, but the entrance is now dry at low water. This change was brought about at the time of the last eruption, less than ten years ago. That it was due to an elevation of the bottom and not to choking by the fall of erupted material, is evident from the presence of a number of more or less stunted spruce trees near the shore, which are evidently older than the eruption and would have been killed or buried by the fall of material sufficient to choke the harbor. The peak has the regular volcanic form, the rim of the crater being somewhat broken away on the west and north. Steam issues in intermittent puffs from the crater and inner cone, and when these puffs rise vertically and spread out like a mushroom above the peak, it is taken by the natives as an evidence of several days of calm weather, during which they do not hesitate to put out far from shore in their frail kayaks to hunt the sea otter. Dr. Geo. F. Becker and Mr. C. W. Purington of our party ascended the peak, which is some 3,000 feet in height. This was probably the first ascent which has been made, as there is no record of any previous visit by civilized explorers. The eruption referred to was accompanied by tidal waves and vast clouds of ashes, which were wafted to a great distance. On the west side of the inlet hundreds of square miles of spruce forest was killed by the load of wet ashes which descended on this occasion.

The upper two-thirds of the peak are largely snow-covered; below much is bare ashes and scattered lava blocks; then more or less herbage, with stunted spruce, sparsely scattered, and low, creeping alders. The borders of the island to the south and west are low, hummocky, and with many bogs and small pools. The south shore has bluffs of variable height, none very high. The passage west of the island is foul near the island shore, but has a navigable passage rather closer to the mainland shore.

Our next anchorage was at Tūxed'ni\* Harbor, between the peninsular shore and Chasik Island (properly Khasik, but locally indicated as Chisik on some charts), of which no chart exists. That a snug harbor is to be found here is noted on a sketch chart of the U. S. Hydrographic Office,† but that the bay is five or six miles long, free from dangers, and forming a spacious anchorage, would hardly be supposed from the very imperfect indications given on the best charts. Chasik Island is narrow, and rises over 2,000 feet in height, with bluff shores, the water bold-to. There is a small,

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\* The correct form of the name was carefully recorded from native testimony.

† Notice to Mariners No. 4, Jan. 26, 1895, p. 50.

round, high rocky islet outside of Chasik which forms a convenient landmark for vessels feeling their way along shore in fog, which sometimes conceals the entrance. The southern end of Chasik is high and narrow, with no reef or rocks off it, as has been erroneously stated. The strata are somewhat inclined to the south near the entrance, but in the main are nearly horizontal and composed of heavy beds of sandstone and conglomerate of varying hardness, so that the upper part of the island weathers into steps like terraces on a grand scale, offering a remarkable castellated appearance to the spectator. The scenery here is very fine and peculiar in its features. The splendid volcanic peak of Iliamna rises among the mountains SW. by W. from the harbor at a distance of some fifteen miles. Its upper part is set with glaciers, but the conical form and scenic beauty of the peak can only be fully realized from a greater distance. The fairway of the harbor is nearly straight, with high and singularly weathered cliffs rising on either hand. Toward the head it widens a little. Here good holding ground may be had in 18 fathoms. At this point the vessel which carries down the product of the salmon canneries from the inlet is anchored for the summer. The canned salmon is brought to her by small, light-draught steam tenders, which can cross the shallow water on the bars of the rivers at Kassiloff and Nenilchik, where the salmon are taken.

From Capt. Hughes we learned that the spring tide in June was 36 feet; at ordinary times the range is about 24 feet. The northern end of the harbor is protected by reefs and foul ground beyond Chasik Island, where there is a large, open bay. There may be a channel out this way, but until it is surveyed it would be imprudent to attempt the passage except with small craft. Into this bay a large river falls, fed by the glaciers of Iliamna and the drainage of the other mountains. The north end of Chasik shows high bluffs, rising much above those on the main shore, and above is a magnificent castellated summit of curiously eroded, almost horizontal, beds of sandstone, limestone and conglomerate, which can hardly be less than 2,000 feet in elevation. Near the beaches the rocks are worn into caves, arches and pillars, about which circle innumerable multitudes of sea birds.

There is no bar or obstruction at the entrance of the harbor, but the great range of the tides and the narrow form of the harbor produce well-marked rips at certain stages of the tide, which might lead to the supposition that rocks or shoals exist. On the island side the shores are bold-to, on the main, at the head of the harbor,

shoal for a long distance from the beach. Notwithstanding the absence of protection at the entrance, southerly winds do not blow home into the harbor on account of the high land on either side; but, for the same reason, wind from the land is often stronger in the harbor than out in the inlet. July 23d, 1895, flood tide made shortly after 3 P.M.

All the navigation in the upper part of Cook's Inlet is commonly carried on with reference to the tides. A sailing vessel can make no headway against them, and it is the custom to anchor during the unfavorable tides, which can be done almost anywhere along shore. In pursuance of this practice, we anchored off the West Foreland, where there is a small village of Koo-tena Indians. Here the shore is of bluffs, apparently about fifty feet high, of gravel and sand, wooded above, with some high mountains distant in the interior.

We had slack water about 10 A.M., July 24, and started for North Foreland with the flood tide. Between the two Forelands is a wide bay, with shoal water and many scattered boulders rising out of it along the shore. The land behind is very low in part, all heavily wooded with spruce, and a river carrying very muddy water comes in here. Near the North Foreland is a series of whitish gravel bluffs of very regular height, with a broad beach and shallow water for a mile off it; with scattered—sometimes very large—squarish rocks of whitish color irregularly distributed over the flats. There are Indian houses in the principal gap in this series of bluffs, but the largest settlement, Tyónék, is near the point of the Foreland, where a small gravel flat exists. Here the water off the beach for half a mile is shoal, but not foul. Off the Foreland southward, in the middle of the inlet, most charts show an area enclosed by a dotted line connected continuously with foul ground on the southeast shore of the inlet. This is an error, as there is a clear passage on each side of the central patch, which latter trends with the inlet and shows at low water large, bare sand-banks, eight or ten feet high. East of North Foreland and between it and Point Possession, also in the middle of the inlet, is a flat or shoal not shown on the charts and which constitutes a serious danger. It is believed to be five or six miles long and not less than four miles wide, its southern edge about WSW.\* from Point Possession.

The village of Tyónék is small, without a harbor, and the spot is inaccessible by sea in winter, as this part of the inlet freezes over. The tide is from 25 to 35 feet in range here, with a depth of  $3\frac{1}{2}$  fathoms half a mile off the beach.

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\* All bearings in this paper are magnetic.

Turnagain Arm extends to the eastward from Point Possession and is the passageway to the placer mines, of which much has been said in the public press. Dr. Becker's report upon these will be published by the U. S. Geological Survey.

The following notes may have some importance in view of the influx of population and the necessities of navigation: North-easterly from Pt. Possession on the continent the land is mostly low, formed by the delta of the Sushitna River, but at some distance inland rises a low but conspicuous peak known as Sushitna Mountain, west of the river, and a noted landmark. Eastward from the Sushitna another, the Knik or Fire River, enters the inlet north of Pt. Campbell. West of Pt. Campbell is a small, high island called Fire Island, to which sufficient water for an ordinary schooner may be had at low tide, according to local navigators. Both at Point Campbell and Point Possession the land is low and wooded, but about twelve miles eastward of the latter the mountains come to the water's edge, with narrow steep-sided ravines and cañons, in which are the streams where gold is washed. The land rises to about 2,000 feet; some of the peaks are perhaps higher, and the slopes are rather sparsely wooded. The rise and fall of the tide in Turnagain Arm is remarkable, and the middle of the passage, as well as much of its margin, is occupied by extensive flats partially dry at low water, with a shallow channel at each side. To enter the Arm and avoid the shoals keep Pt. Possession well aboard and steer for the northern edge of the high land on the south side of the Arm; keeping a little to the southward of a straight course between the two, and the lead constantly going, as the shoals shift to some extent. Allow for a tide of fifty feet in range, and select an anchorage in accordance with the circumstances of the case. The northern channel is not navigable eastward of Fire Island, and the island is nearer to Pt. Campbell and rather more southerly in position than indicated by existing charts. The shoal in the centre of the Arm is elongated, trending with the inlet and not rounded as on the charts. These shoals are mostly hard sand, with a few scattered boulders.

We anchored under the lee of a small, high, conspicuous rocky bluff, the first east of Pt. Possession, where the miners assured us there was always water enough to float our little tug. It is hardly necessary to repeat that here one can only move with a fair tide. At our anchorage, with the standard compass we found Pt. Campbell bearing W. 40° N., the north edge of Pt. Possession W. 10° N., the SW. edge of Fire Island in one with Pt. Campbell, Mt.

Sushitna NW.  $\frac{1}{2}$  W., and the bluff point a cable's length to the east.

We left North Foreland with the flood tide immediately after it turned at 2 A.M., July 25th, and at 8 A.M. found high water at the bluff above mentioned, with 41 feet of water under us. There was a slack of about fifteen minutes. At 9.15 we put out the patent log to test the strength of the ebb, and found it to average three and a quarter knots during the first half, though we were out of the strength of the tide. It was slack water at 3.30 P.M., and there was less than two feet of water under our bilge, showing a range for this day of 39 feet at this point. We were obliged to await the bore helpless on the sand, and it did not keep us waiting long, but came in with a rush in a wave three or four feet high, which whisked us a mile and a half up the inlet before we could get out another anchor; and here, with full steam ahead and both anchors down, we had all we could do to keep her from dragging. The log showed a seven-knot current, and the water after the bore had passed rose six feet in ten minutes. At extreme spring tides the ebb would leave this anchorage dry and for a mile or two seaward. The force of the current was such as to twist our main anchor, weighing 250 pounds and of good Swedish iron, in two different directions. It was a fit object for a museum when recovered. We were happy to leave Turnagain Arm with the turn of the tide. Off the high land west of our anchorage is a small, high island called Haystack by the miners. It rises out of the flats, which dry all around it at low water.

Two days later we entered Kachekmak Bay, on the eastern shore of the inlet. This locality is interesting on account of the presence of extensive deposits of brown coal, and because it is the finest harbor in the inlet, never obstructed by ice, and one of the finest on the whole Pacific coast. The native name of the bay is Kachekmak, in allusion to the high bluffs of the northern shore; the natives of Chugach Bay (Prince William Sound) in coming to the inlet made a portage from the Pacific to the head of this bay, and so reached the Russian trading post at Port Graham, so the traders called it the bay of the Chugachi, or Chugachik. The native name was misspelled on an obscure map without the central "k," and although the Coast Survey in the first and only special chart of the bay gave the correct spelling, the Board of Geographic names adopted the incorrect form, which thus becomes obligatory in all Government publications.

This harbor separates the comparatively level plateau of the

Kenai Peninsula west of its axial mountain range from a spur of that range which comes down to the sea at Pt. Bede, with several indentations affording anchorage.

These mountains are not very high, but from them descend several attractive glaciers not difficult to reach. One of these I had visited in 1880 and sketched its terminal moraine. On a second visit in 1895 I found it had receded about 250 feet from its old terminus. The rocks on this side of the bay are mostly crystalline or eruptive, forming a marked contrast to the bluffs of nearly horizontal sandstone and clays with conspicuous coal seams which border the opposite shore. The harbor is protected by a long, low spit of gravel, within which is good anchorage close to the shore, but the beach in front of the bluffs makes off shoal for two, or, toward the head of the bay, fully three miles. We observed the range of tide in the upper bay to be 22 feet; at springs the extreme range is said to be thirty in the upper part of the bay and somewhat less toward the entrance. Excepting a few buildings connected with the work of coal prospectors there is no settlement within the spit. In the lower bay outside of the harbor is a snug anchorage, Chesloknu of the natives, Seldovia or Herring Bay of the Russians. Here are two trading stations, and most of the inhabitants from Port Graham, where the harbor is less convenient, have migrated to Seldovia village. There is quite a collection of houses and a Greek chapel. No chart has been published of this anchorage except a small delineation from a Russian sketch which is included in the chart of Kachekmak Bay, compiled by the Coast Survey in 1880. The bluff at the SE. head of the entrance is composed of two small rocky islets united to each other and to the mainland by a low spit, so that the land is not continuously high as represented on the sketch alluded to. The entrance has rocky bottom clear across, with kelp growing in five and a half fathoms. The northern head is bluff and rocky, a rounded boulder lies off it, visible at low water. There are also rocks above and below water about the opposite headland. Inside there are seven and eight fathoms, sandy bottom, off the village in mid-harbor, with protection from all winds except NW., and at the head of the harbor complete shelter.

On the first of August we visited Amalik Harbor, behind Takli Island, on the south side of Aliaska Peninsula. We found excellent shelter from all winds and anchorage in ten fathoms sand. A long inlet penetrates the land here which has never been surveyed. The rocks are mostly coarse sandstones pierced by volcanic dykes, and contain seams of a superior quality of brown coal.

The next point visited was Cold Bay of modern charts (Studenaia or Frosty Bay of the Russians, Puale or Pūālū Bay of the natives), a fine sheet of water of which no charts exist and the indications on the general charts are very inaccurate. The entrance is partially obstructed by an area of foul ground, with rocky islets and pinnacles extending to the SW. from the northeastern point of entrance for several miles. Another patch, separated by a clear passage, is nearly in the middle of the entrance. The Russian Hydrographic Chart of 1848 shows these with more accuracy than any of the later maps, but barely indicates the inner shores of the bay. Cape Yaklok (Jäklok of some charts) forms the SW. headland and is free from off-shore dangers.

There is just within this cape a small spit of heavy shingle, with high rocky bluffs behind it. Here anchorage may be had in good weather, and the camps of sea-otter hunters are often made.

There is no settlement in the bay, which is divided into two arms by a high promontory near its head. The western arm terminates in low flat land, behind which is a large lagoon, dry at low water, into which empties a rather large stream. The land at the head of the eastern arm is higher. Most of the topography about the bay is high and barren, the rocks lying in nearly horizontal heavy beds of sandstone and conglomerate, which weather into benches and offer scenery of much impressiveness.

It somewhat recalls that at Chasik Island, but the mountain forms are more massive and simple, with long, even talus slopes, due to the disintegration of the rather friable shales, which are interbedded with the sandstones. Near the water the bluffs were curiously eroded by the sea and weather, and sheltered myriads of sea fowl. Singularly enough, though the rocks in hand appear brown or gray, the effect of them in distant masses was a marked brownish purple, giving the landscape a peculiarly chilly aspect, which well deserved the name applied to the bay. On the northeastern shore a stream comes in from a conspicuous valley, off which, on a gradually deepening flat, anchorage may be had in any depth desired. The water in most other parts of the bay is inconveniently deep. The shores near this place are of low bluffs of very massive light gray limestone, without fossils, which falls in enormous blocks, worn by the sea afterwards into very remarkable spheroidal forms. From the high land about the bay in windy weather heavy gusts sweep down, but the holding ground is good and the anchorage at this point sufficiently protected from the sea. The absence of trees gives an individuality to the landscape which

is very striking when one comes from the densely forested slopes of eastern Alaska.

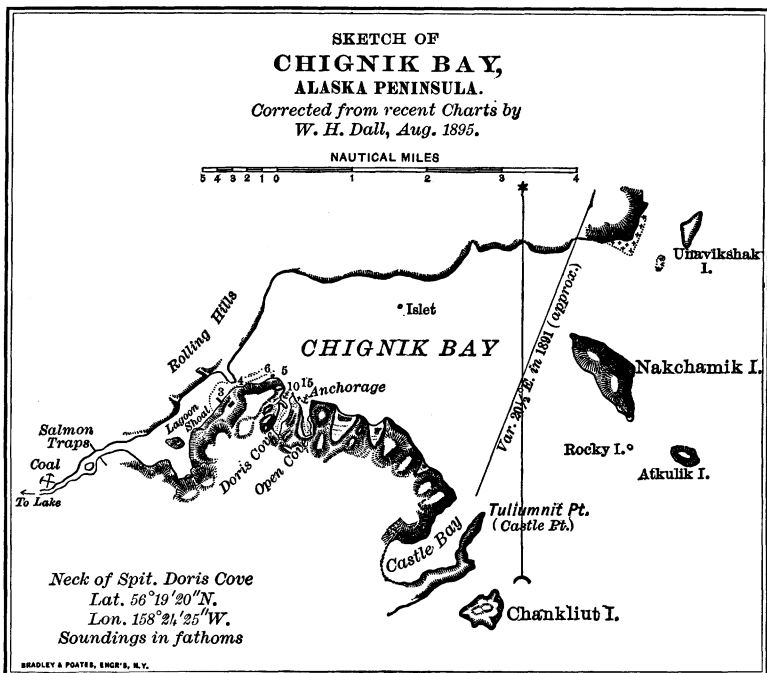
In Kialagvit Bay, further west, we have another large uncharted sheet of water, defended from the sea by a long line of islets. The indications of the general charts are very inaccurate. The bay at the eastward leading to the Becheroff village is clear of dangers, except near the points of entrance, where foul ground extends well off shore, and near the village where the water gradually shoals for two miles off the beach. There is no conspicuous mountain recognizable as the one on the charts near the village. The mountains resemble those of Cold Bay but, as the strata are inclined more steeply, do not show horizontal benches.

The entrance to the inner bay is rather close to the outer islets, with two or three fathoms over a bar. Within there are no invisible dangers and the water is mostly quite deep. There is a second entrance west of the first cluster of islets, with a clear passage and deep water according to a local pilot. There are several visible rocks there, but no hidden dangers. The portage to the Ugashik River of the northern slope of the peninsula, begins in a valley near the western end of the inner bay. At the extreme southwestern end rises the Olai volcano, from which on its eastern flank a large glacier descends; while on the seaward slope two others come down from the same *massif*. It is incomprehensible why all the charts should place Mt. Olai north of the bay and nearly midway of its length, since there is no volcano and no conspicuous peak in that situation. The mountains slope gradually toward the beach, covered with dense herbage, and near the portage is a notable locality for mesozoic fossils, where it would not be difficult to load a ship with ammonites.

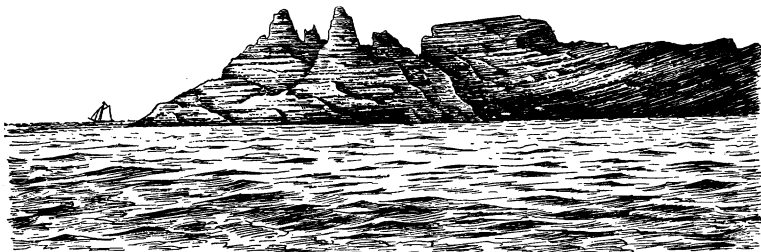
Chignik Bay, still further west, is a better known locality, which has suffered exceedingly from the attempt to combine the Applegate sketches with the previously existing data. In this process the bay has, on the resulting chart, been reduced to about one-half its proper area, while the characteristics of its southern shore have been grossly exaggerated in relation to those of the east and north. Nakchamik Island, which lies off the bay, has been brought within half the proper distance of the northern part of the Semidi group, and the great lagoon has been represented as wholly sanded up.

Chignik Bay is sufficiently represented in the sketch here given to require no detailed description, but a few notes will be of use to navigators in advance of a fuller survey.

The bay opens to the eastward with no concealed dangers. Its south point of entrance is Tūliūm'nit Point, a remarkable headland,



sometimes called Castle Point, which forms a landmark for navigators in this vicinity. The sketch of this headland herewith, bearing SSW. one mile distant, is made from a photograph taken on ship-board by Mr. Ezekiel, of Woody Island, Kadiak, and kindly pre-



TŪLIŪM'NIT POINT, CHIGNIK BAY, SSW. 1 MILE.

sented by him. The point is extremely narrow and composed of tertiary sandstones, forming a shallow syncline, the stratification

being a conspicuous feature. North and west of the point is a deep indentation known as Castle Bay, unsurveyed, but which is said to afford anchorage on its northwest side. The grassy highlands west of the bay afford feeding grounds at times for the wild caribou, and by driving them on to the narrow point (which at one place is only a few hundred feet wide), large numbers are said to be secured by hunters. The south shore of Chignik Bay west of Castle Bay is bluff and high, with four indentations, the two to the east being closed by bars of gravel behind which shallow lagoons exist, while the two further west afford anchorage. The westernmost, named Doris Cove, is a snug and perfectly protected harbor and was surveyed by the U. S. Coast Survey in 1874. Here the vessel which serves the associated salmon canneries is anchored during the season. The extreme southwestern corner of the bay is marked by a round-topped vertical bluff, at the foot of which is the entrance to Chignik lagoon, protected by a long sandspit with a navigable channel between it and the bluff. Although this passage is represented on the later charts as entirely sanded up, there is a least depth of two fathoms on the bar and 22 feet of water at high tide. The channel is moderately wide, and inside the entrance offers three to five fathoms over sandy bottom as far as the canneries, beyond which the lagoon is shoal. At high water a three or four foot channel leads to the head of the lagoon where a river enters, at the mouth of which are the salmon weirs. A light-draught stern-wheel steamer affords transportation, and there is water enough in the river to permit the ascent of this boat several miles to a point where a seam of brown coal is worked by the association for use in the canneries. The catch of salmon from this single stream annually amounts to about five million pounds of fish. It was high water in the lagoon about 1.30 P.M. on August 4th. The river is bordered by vertical banks of tertiary rocks thirty or forty feet in average height. Two or three miles above the coal mine the river issues from a large lake, said to be six or seven miles long and connected with another, equally large, by a stream five or six miles in length. The topography is rolling, with low hills and a wide expanse of tundra on which caribou find grazing.

An important centre of trade, fisheries for cod, and gold mining, is found in the Shumagin Islands, at Delaroff Harbor, Unga, and Sand Point, a few miles above. The harbor of Delaroff village has not been surveyed, though a small Russian sketch was printed many years ago. It consists of an outer roadstead surrounded with

rocky cliffs, where vessels may lay to a mooring; and an inner lagoon which has been stated to be silted up. We found, however, that good anchorage for vessels drawing not more than twelve feet may be had inside the entrance to the lagoon. This is important, as the outer bay is unsafe in southeast gales and several wrecks have occurred there. The anchorage is in mid-channel in three and a half to five fathoms, with a lee afforded by a reef and kelp patch on the south side of the entrance. A dangerous rock exists off the outer roadstead which I found to lie SE. by E.  $\frac{3}{4}$  E. from the middle of the entrance to the lagoon. Going out we found the breaker in line with the trend of the point at the south head of the outer bay. From the inner anchorage the visible south end of Nagai bore E. by S.  $\frac{1}{2}$  S., the inner north headland E. by S. and the rock at the south headland S.E. by S.  $\frac{1}{4}$  S. by compass.

A visit to the volcano islands Bogosloff and Grewingk, west of Unalashka, afforded many notes of interest, but my companion, Dr. Geo. F. Becker, in charge of our party, contemplates a special report upon these islets, so I will close these hydrographic notes by stating in the interest of navigation, that the long spit of ash and volcanic gravel which formerly connected the two volcanoes is now broken by a navigable passage (the existence of which has been recently mistakenly denied), directly over the spot where for more than a century Ship Rock of Cook towered in solitary majesty. The newer Grewingk volcano gives out but little steam, and the peak which at first surmounted it has fallen in or crumbled away until the upper part of the island is approximately level, or appears so from the sea. From the southeastern side of the island a long, low falciform spit extends, off which in fair weather protection may be had from westerly winds, and parties desiring to visit the volcano may, with care, effect a landing.